MENDELISM FOR THE BLIND

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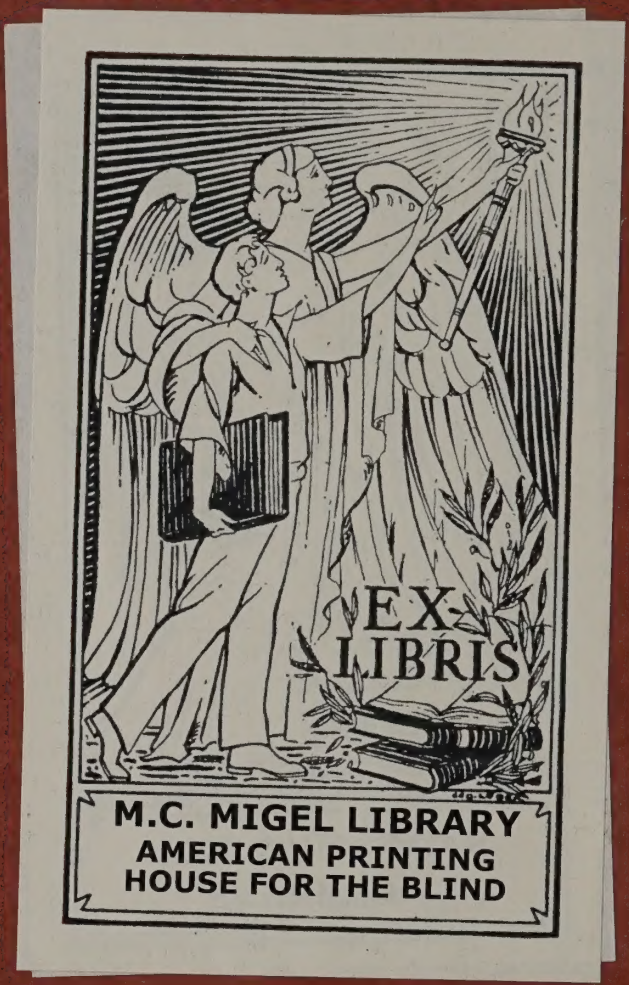

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MENDELISM FOR THE BLIND

Laboratory Courses in Biological Sciences Successfully Taught to the Sightless

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THE increase of educational opportunities for the blind has brought a growing number to college. Here they are faced with the requirement of a "laboratory science" for graduation. This has usually been waived as unreasonable in application to the sightless.

A number of years ago a blind student was carried through the General Zoology course at the University of Pennsylvania by Professor H. S. Colton, using plastocene for modeling special structures and commercial models for the grosser details.

The presence of several blind students at the University of Pittsburgh led me to experiment with methods of instruction. Wire solder and soft aluminum wire twisted into the desired shapes and cemented to cardboard took the place of outline drawing usually done with chalk on the blackboard. Eventually labels in Braille were attached to these wire drawings making them permanently useful. Such stand-bys of biological instruction as Euglena, Paramoecium, and Hydra have been made "visible" to the blind through the medium of such "drawings."

Wire "Genes"

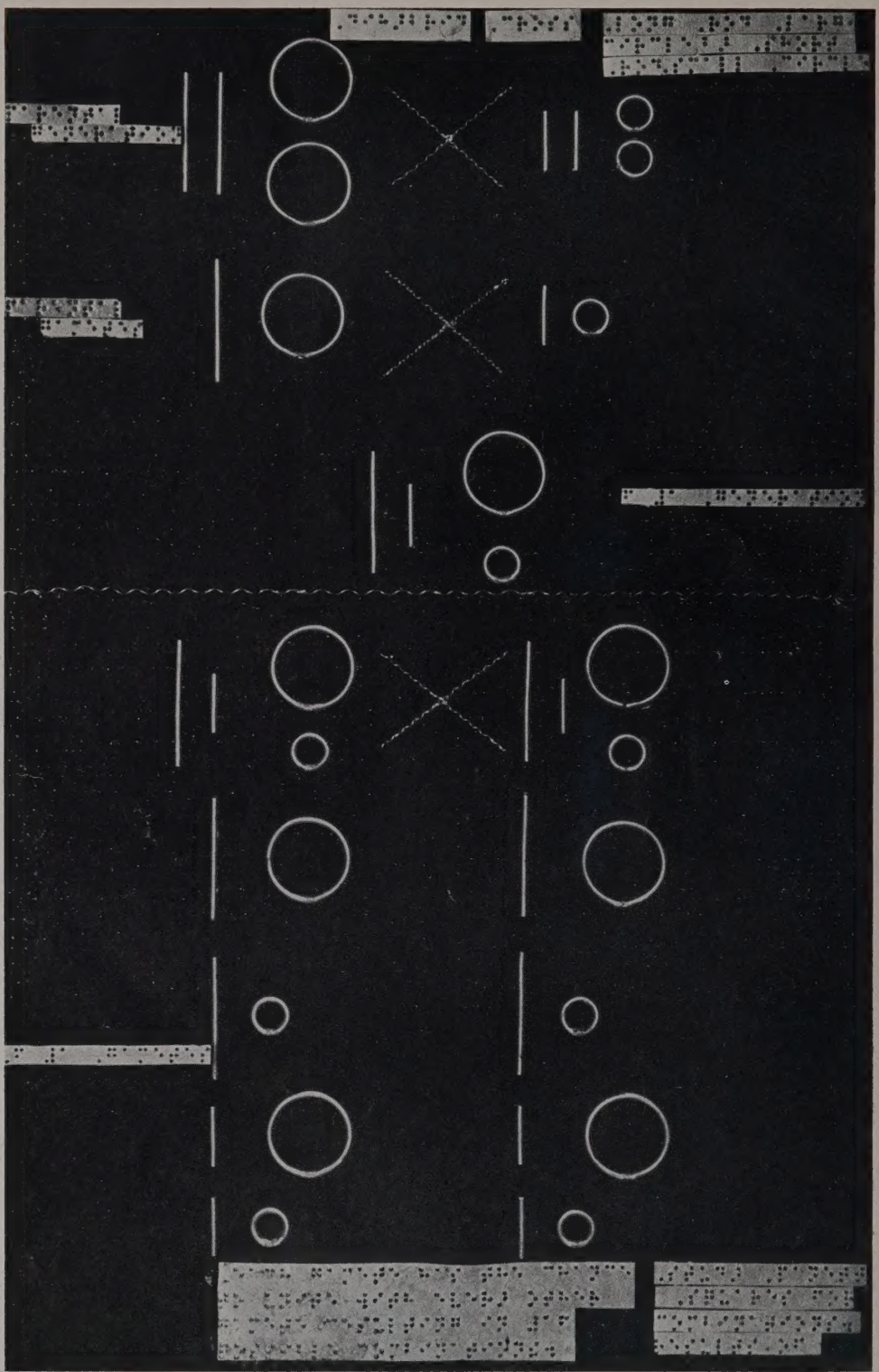
In anticipation, Mendelism seemed to offer the most serious difficulties of presentation. In the end it proved to be the simplest and most satisfactorily solved of all. Characters or genes were represented in bits of wire of varying shapes and sizes. The larger shape was assumed to be dominant to the smaller one. The photographs (Frontispiece) show the Mendelian result in the F_1 and F_2 generation of monohybrid crosses between long and short rods and large and small circles. The outcome of the F_1 of a dihybrid cross between long rod, large circle, and short rod, small circle is shown in Figure 4, while the F_2 combinations are worked by using a specially-constructed Punnett Square. Sixteen large boxes are joined together, with four small ones across the top to hold the gametes of one parent and another four flanking the left side to hold those of the other. The large boxes contain the results of the union of the appropriate gametes.

This device has seemed to give our blind students a very good concept of the principles of Mendelism. The concreteness of the genes has also seemed to help those students who had eyes but little imagination for genetic phenomena.

Frontispiece. The figures on the left side of the plate represent, for the use of the blind, a simple Mendelian cross between a dominant long and a recessive short rod. The gametic makeup of the parental generation is shown at the top followed by their gametes and then by the F_1 results of their union. The heterozygotes are set up for crossing in the next lower diagram. The genetic condition of the gametes are next indicated with the 1:2:1 ratio demonstrated in the final row. The rods and circles are made of wire solder and all of the spiral lines were constructed of soft aluminum wire. All steps in the process are described by labels written in Braille.

Figure 4. A dihybrid cross between long rod, large circle and small rod, small circle is illustrated. First row shows P_1; second row P_1 gametes; third row the F_1 generation and the fourth row pictures a cross between two F_1 heterozygotes followed by the four possible gametes.

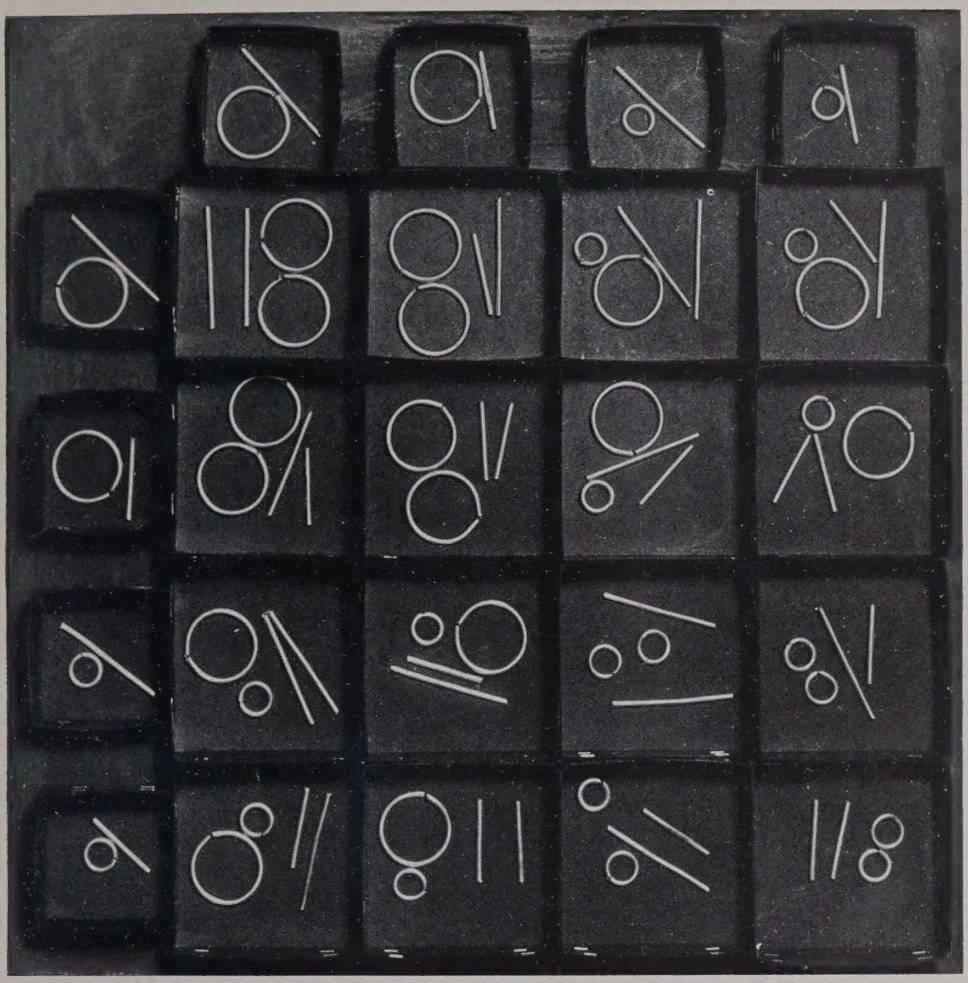
Figure 5. Punnett squares made of small boxes. The gametic combinations are contained in the four small boxes at the top and down the left side of the



A TWO-FACTOR CROSS DIAGRAMMED FOR THE BLIND

Figure 4

Cross between a form pure for two dominant characters (long rod, large ring) and a form pure for their two recessive allelomorphs (short rod, small ring). The four types of gametes formed in the F_1 are shown in the lower part of the illustration. The "checkerboard" showing the union of the four types of gametes to produce 16 genetically different types in F_2 is shown in Figure 5.



AN F_2 "CHECKERBOARD" FOR THE BLIND

Figure 5

By use of cardboard boxes and wire symbols the 16 genetically different combinations obtained in the F_2 of a cross involving two independent pairs of Mendelian allelomorphs is charted for the blind. So clear is this form of symbolism that it may have advantages even for seeing pupils of genetics. The blind have no difficulty in apprehending the basic principles of Mendelian heredity with this apparatus.

figure. The sixteen possible combinations are contained in the various boxes. The blind student can determine by feel the makeup of the gametes and then can check the results of crossing by feeling the contents of the proper large box.

A WHEAT-RYE HYBRID

Figure 6

An F_1 hybrid (*B*) between (*A*) Honor wheat (*Triticum vulgare*), and (*C*) Rosen rye (*Secale cereale*). Eight F_2 plants all had 56 chromosomes, and are therefore classified as amphidiploids, since they assumedly carried a complete diploid chromosome set from each parent species. (Rye diploid chromosome number = 14: vulgare wheat = 42. 14 +42 = 56.) In such a hybrid, orderly pairing of the chromosomes in the formation of germ cells may take place an´ normal fertility is possible.

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